CSSHE
SCÉES
Canadian Journal of Higher Education
Revue canadienne d'enseignement supérieur
Volume 39, No. 2, 2009, pages 101-120
www.ingentaconnect.com/content/csshe/cjhe

A Graduate Teaching Assistant Workshop in a Faculty of Science

dik Harris
McGill University

Laura April McEwen
Queen's University

ABSTRACT

This article describes the design and implementation of a workshop on teaching and learning for graduate teaching assistants (GTAs) in a Faculty of Science at a major Canadian research-intensive university. The approach borrows heavily from an existing successful workshop for faculty but is tailored specifically to the needs of GTAs in science in an environment where departmental resources are largely absent. Thus, the workshop is unusual in that it finds a midpoint between centrally administered, discipline-neutral programs and those that are discipline specific. Equally, it is unusual because it was conceived, implemented, and continues to evolve through the active involvement of teaching fellows, themselves GTAs, who receive particular preparation for their role. The approach is discussed in relation to other approaches found in the literature.

RÉSUMÉ

Dans cet article, les auteurs décrivent la conception et la mise en œuvre d'un atelier de formation à l'enseignement et à l'apprentissage destiné aux assistants à l'enseignement aux cycles supérieurs (AECS) dans une faculté de sciences à une grande université de recherche canadienne. La méthodologie de cet atelier, fortement empruntée d'un autre atelier

actuel, ayant une certaine réussite, et étant destiné aux professeurs, a été adaptée aux besoins particuliers des AECS en sciences tout en tenant compte du grand manque de ressources au niveau du département. Ainsi, cet atelier est unique, car il cible un juste équilibre entre un programme administré centralement et indépendant de la discipline avec ceux qui sont spécifiques à chaque discipline. De plus, cet atelier est exceptionnel car sa conception, sa mise en œuvre et son évolution continuelle sont directement liées à la participation active d'un groupe de « teaching fellows », eux-mêmes assistants à l'enseignement et formés spécifiquement pour leur rôle. L'article compare cette approche à d'autres tirées de la littérature scientifique dans ce domaine.

INTRODUCTION

The widespread use of graduate teaching assistants (GTAs) in North American universities is well documented (Golde & Dore, 2001). Their functions are many, including the teaching of discussion sections (tutorials), the supervising of laboratory sections, and, particularly in the Humanities, the teaching of lecture courses (Golde & Dore, 2001, 2004). Additionally, they are often called upon to grade student work (Luo, Grady, & Bellows, 2001; Pruitt-Logan, Gaff, & Jentoft, 2002). In these roles, their presence is most apparent in large, introductory (freshman) courses, where they are often the primary contact for undergraduate students (Luft, Kurdziel, Roehrig, & Turner, 2004; Travers, 1989). This situation is particularly common in the Sciences, where compulsory introductory courses represent a significant portion of the teaching load for many departments.

In recent years, there has been increasing recognition that better preparation of GTAs for their teaching functions is necessary (Shannon, Twale, & Moore, 1998); pressure for this change has come from several different directions, including employers and leaders of government agencies, higher education associations and foundations, and parents (Austin & Wulff, 2004; Luo et al., 2001). Equally, there has been recognition that preparation for teaching is a crucial aspect of preparing the next generation of faculty members, and the ongoing Preparing Future Faculty (PFF) initiative (Pruitt-Logan et al., 2002; PFF, 2009) is now well established on many American campuses. Recent data compiled by Schönwetter, Ellis, Taylor, and Koop (2008) for North American universities offering graduate degrees indicate that around 18% of them now provide such preparation, in a variety of formats. In Canada, there was a threefold increase in this percentage over the 10 years from 1992 to 2002.

Another interesting statistic reported by Schönwetter et al. (2008) is that the preparation is almost always sponsored by a unit at arm's length from the academic departments of the GTAs. Teaching centres, faculties of education, and faculties/schools of graduate studies head the list of sponsors, and the only units or departments not explicitly linked to education are departments of psy-

chology, which represent around 4% of the total. It is perhaps not surprising, then, that the analysis of course objectives and content found in their article rarely reveals discipline-specific material.

Indeed, this suggests that the disciplinary issues related to the preparation of GTAs in the Sciences (Luo et al., 2001) are seldom given particular attention. On the one hand, these are the same issues that confront programs that prepare (new) faculty members for their teaching role, that is, the extent to which university-wide, generic programs can address discipline-specific learning styles (Kolb, 1994) and "ways of thinking" (Entwistle, 2005) or can incorporate "pedagogical content knowledge" (Shulman, 1986). On the other hand, there are issues more specific to GTAs in the Sciences that arise from the particular responsibilities they are often assigned – supervising laboratories, grading, and assisting with problem sets – the characteristics of which neither correspond to teaching responsibilities in the Humanities nor coincide with the typical responsibilities of new faculty members in the Sciences. There is also evidence that GTAs in the Sciences are less likely to experience "progressively responsible roles in teaching" (Golde & Dore, 2001, p. 22; 2004) and therefore feel significantly less prepared for their teaching roles than their counterparts in the Humanities.

Initiatives that address the particular responsibilities of GTAs in the science disciplines are typically at the departmental level, which underlines the reality that substantial differences exist even within faculties of science, for instance, between physics and biology. Examples in the literature include biology (Tanner & Allen, 2006), chemistry (Roehrig, Luft, Kurdziel, & Turner, 2003), physics (Lawrenz, Heller, Keith, & Heller, 1992), and mathematics (Speer, Gutmann, & Murphy, 2005). Although such initiatives are often associated with pre-existing university programs (Luft et al., 2004; Marincovich, 1996), the general consensus is that there is no "one size fits all" recipe for the balance between generic and discipline-specific material (Hiiemae, Lambert, & Hayes, 1991; Jones, 1991; Ronkowski, 1996; Rushin et al., 1997; Wulff, Nyquist, & Abbott, 1991). When disciplinary issues are addressed, this happens, in different ways in different places, to fit local environments and resources.

This article presents an approach to a program for GTAs in science that was created in an environment where there was neither a university program nor widespread departmental initiatives and where resources were limited. The approach is unusual for two reasons: it is faculty wide rather than based in individual departments, and so finds a middle ground between generic and discipline-specific content; and the initial lack of resources was finessed by employing GTAs to design and implement the program themselves. In the sections that follow, the context in which the approach took shape, the design process, and the program implementation are described, and the decisions that were made in relation to the relevant literature are discussed, with the intention of providing others with the information necessary to consider and implement a similar initiative in a similar context.

THE CONTEXT

The context of the particular approach reported in this article is a research-intensive university in eastern Canada. Currently, the university has a total enrolment of approximately 30,000 students, of whom 8,500 are graduates, and there are 1,500 academic staff. It has 11 faculties, of which the Faculty of Science is one of the largest, with approximately 3,200 undergraduates, 850 graduates, and 220 academic staff. Graduate teaching assistants (GTAs) are widely employed to support the teaching of undergraduates, notably in the first-year (freshman) courses. Until recently, the university has had no institution-wide program for preparing GTAs for their teaching roles, although within the Faculty of Science there are individual initiatives, notably within the Department of Psychology. However, there is a well-established Centre for Teaching and Learning, which offers a range of services to academic staff, including individual consultations and workshops.

One service offered by the centre is particularly relevant to this article. It is a week-long intensive workshop for academic staff that uses course design as the entry point for a comprehensive introduction to issues of teaching and learning (Saroyan & Amundsen, 2004). The workshop also exists as a semester-long credit course entitled Teaching and Learning in Higher Education (Saroyan & Amundsen, 1995), which is for graduate students who are potential or actual GTAs; some university departments, although none in the Faculty of Science, require their doctoral students to take this course. The course-design process is a central focus of this course, but its extended semester-long format provides additional opportunity to discuss and digest, in depth, issues related to teaching and learning in higher education. Further, students have the opportunity to practice their teaching skills in multiple micro-teaching sessions. A typical course description and typical learning outcomes for this course are provided in Appendix 1.

THE CHALLENGES: AN OVERVIEW

The Tomlinson University Science Teaching Project has as part of its mandate "to support the development of more effective teaching methods for university level students and the dissemination of these techniques to the professoriate" (Tomlinson Project, 2009). At its inception in 2002, the project had a small academic staff of two, including the director, who had no relief from his normal academic responsibilities, plus a part-time secretary. Given the context of the project, notably the absence of a university-wide program for GTAs and the absence of substantial departmental initiatives in the Faculty of Science, it was decided that the development and implementation of a program specific to the faculty would be an appropriate use of the Tomlinson Project funds and resources. Other uses included the support of course-design initiatives, with both financial and human resources; an example is described in a 2009 article by McEwen et al.

The immediate challenge was how, with limited resources and without compromising the other aspects of the project's mandate, to provide any program for the faculty as a whole. Concretely, who would design and implement it, and who would be its instructors or facilitators? Neither of the Tomlinson Project staff had sufficient time nor could claim to possess all the necessary expertise. Although a familiar challenge (Hiiemae et al., 1991), it was in a particular context that required a particular response. Equally clear was the challenge of addressing the specificity of a Faculty of Science, while still respecting the disciplinary differences that exist between departments (psychology, geology, physics, biology, etc.). An entirely generic, discipline-free approach did not seem appropriate, but a discipline-specific approach, based in the departments, was impractical, given the limited resources. Although this was the same challenge faced by any institution creating a new institution-wide program for GTAs (Hiiemae et al., 1991; Luft et al., 2004), it was transplanted into a smaller context and therefore again required a different response.

Teaching Fellows

To address the resource issue, each year the Tomlinson Project recruits four experienced GTAs who become the Tomlinson Teaching Fellows (TTFs). Care is taken to solicit applications for these positions from across the faculty, often, now that the program is established, from program participants. Applicants are asked to detail their teaching experience and to write about their teaching philosophy, as well as what they see as their contribution to the GTA preparation program. The selection process, including interviews with promising applicants, is designed to choose a group whose disciplinary backgrounds mirror the disciplinary diversity of the faculty as a whole.

Recruiting GTAs to work with such a project is not uncommon (Hiiemae et al., 1991; Hollar, Carlson, & Spencer, 2000; Wulff et al., 1991), although unfortunately no review of their various responsibilities seems to exist in the literature. Employing them as instructors or facilitators supplements the often limited resources available, as is the case with the Tomlinson program, and ensures continuity and renewal. Equally, this approach builds in the significant advantages of "peer-to-peer" teaching, as described below. However, the first unusual aspect of the program is that the original four TTFs were not only employed as its facilitators but were also asked first to help answer its design questions and then to design it. Likewise, their successors are not only employed as its facilitators but also asked to contribute to its ongoing development, work that is overseen by the program coordinator.

Because they come from such diverse backgrounds, the TTFs need a common language for carrying out the design and development work. Academics without exposure to current ideas in education often have to unlearn their preconceived ideas about teaching and learning (Harris, 2004; Menges & Rando, 1989) before they can appreciate the wealth of material available to inform their decision making; indeed, experience with a similar clientele — beginning teach-

ers — has shown that unstructured exposure to such ideas is not necessarily effective (Gonsalves, Harris, & McAlpine, 2009; Hammrich, 1996). Thus, the TTFs are required to enrol in the semester-long credit course Teaching and Learning in Higher Education, a requirement that is again unusual, if not unique, in the context of preparation programs for GTAs. To make it possible, it is necessary to free them from the financial necessity of working as a GTA at the same time and so, until recently, they were paid a stipend equivalent to that of a full-time GTA for the semester.

DESIGN AND DEVELOPMENT

The second unusual aspect of the Tomlinson program is that it is designed for the Sciences as a whole, rather than providing exclusively discipline-specific content. This decision was taken at an early stage by the original TTFs, for two reasons. First, entirely practical, there were insufficient resources to design different programs or different modules for even the principal disciplines represented in the faculty. Second, and more profound, the experience of the TTFs in the Teaching and Learning in Higher Education course had convinced them that the fundamental ideas of education transcended their own disciplines. Only after certain basic ideas were in place did they feel that the disciplinary contexts would become important. At the practical level, they felt that many of the everyday activities of a GTA in the Sciences, particularly grading and conducting tutorials, raised issues that were the same for everyone. This perspective echoed data gathered with the needs-assessment survey questionnaire (see Appendix 2) that was administered to both GTAs and faculty members across the faculty in the first stages of program development.

Once this design issue had been resolved, the original TTFs proceeded to design the program itself. They decided that it should be a workshop, with a modular structure, and that each module should be allocated to an individual TTF. On other issues, given their very different disciplinary perspectives, their consensus guaranteed that the points of view of the eventual participants were respected. The nature of their participation also guaranteed, in a very real way, their sense of ownership of the program, a sense that came to be seen as one of its strengths, generating enthusiasm and ensuring commitment. The Tomlinson Project also takes care to extend this sense of ownership to subsequent groups of TTFs. After taking the Teaching and Learning in Higher Education course, they first become involved in the program as observers or co-facilitators, and subsequently — during the following year — each assumes responsibility for one of its modules. Their particular module is chosen according to which of the existing TTFs are about to leave the program, and they are encouraged to adapt it to reflect their own personal style and experience while respecting its overall design and cohesion. This process of adaptation also offers the opportunity to incorporate the feedback gained from the participants' formal evaluations, an aspect that receives special attention from the coordinator.

THE WORKSHOP

The original TTFs decided that the program would take the form of a workshop lasting 12 hours, spread over three days at the beginning of a semester, before participating GTAs were fully committed to their courses, research, and TA responsibilities. (This was the format offered in Fall 2002; from 2003 onward, the three days were reduced to two.) This decision was again entirely practical, predicated on participation that would be voluntary, without the explicit endorsement of either the departments or the Faculty of Science, and thus could not interfere with pre-established responsibilities or routines. Another factor was the likelihood that the TA union would insist on payment if the workshop were to become compulsory; at the time, there was no budget for such expenditure.

An institutional structure and constraints such as these are not unusual. However, the framework of the workshop is very different from other examples in the literature, whether they are discipline specific or generic. The first TTFs found a middle ground as a consequence of their experience in the Teaching and Learning in Higher Education course and strategically identified those aspects of the course that are specifically relevant to the responsibilities of GTAs in science, namely, an introduction to a contemporary philosophy of teaching and learning (Saroyan & Amundsen, 2004); the framework of constructive alignment (Biggs, 1996) for the organization of curricular materials, teaching strategies, and assessment practices; and an emphasis on active learning, both in the workshop and as a principle for subsequent teaching.

The content corresponding to this framework is such that all examples and activities are meaningful and accessible to all participants, irrespective of their disciplinary affiliation, although discipline-specific material is always employed for illustrative purposes. In this respect, the experience of the TTFs, both in the Teaching and Learning in Higher Education course and in their prior roles as GTAs, is critical. They are very aware that what is familiar to a physicist is not necessarily so to a psychologist (and vice versa). Of equal importance is their contribution to content development, since, with the influx of new TTFs, the repertoire of material is not only updated but also expands to include an ever-increasing diversity of examples and activities.

Underlying the choice of content is the TTFs' identification of the practical responsibilities associated with the roles of GTAs in science. The most important of these are judged to be the grading of problem sets and the leading of tutorials. However, based on their collective experience, the nature of teaching ("demonstrating") in laboratories is judged too discipline specific to be included. Indeed, although this topic is a common feature of programs for GTAs in science, it is usually found in programs that are specific to individual departments (Lawrenz et al., 1992; Luft et al., 2004; Roehrig et al., 2003). Nevertheless, throughout the workshop, participants are encouraged to make links to their laboratory responsibilities.

Another topic that is notably absent from the workshop is an introduction to university policies and procedures, a topic that is often present in centrally

administered programs (Jones, 1991; Luft et al., 2004). Because of the limited time available for the workshop, these important issues are relegated to a supplementary handout, the details of which are given in Appendix 3. Also absent is the topic of students' "misconceptions," which corresponds to the growing literature on ideas particular to a discipline that are wrongly or imperfectly formulated in students' minds. The development of this topic is also judged to be too discipline specific; thus, typically, it is found in programs specific to individual departments (Hammrich, 1996; Lawrenz et al., 1992; Roehrig et al., 2003). Ongoing discussions take place among the TTFs on how best to address these topics, if at all, within the current format.

The form of the workshop now comprises four modules, with each module building on the content of the one preceding it. Opportunities for active learning are a central focus of the instructional design, with numerous learning activities strategically incorporated within every module to allow participants to apply new information and strategies in authentic ways. Short descriptions of the four modules — Linking Theory to Experience; Preparing to Teach; Using Questions to Promote Learning; Grading and Feedback — are given in Appendix 3. The first two modules derive most directly from the Teaching and Learning in Higher Education course. They provide a coherent framework for approaching and planning generic teaching activities and, as such, have much in common with the central elements of the "intensive" courses described by Piccinin, Farquharson, and Mihu (1993) or the Engineering TA Development Program at Cornell (Hollar et al., 2000).

The third and fourth modules provide more practical guidance on conducting tutorials and grading. Again, these topics are prominent in the Cornell program (Hollar et al., 2000), and they are also explicit in the program for physics GTAs described by Lawrenz et al. (1992). Presumably, both topics are also present in the program for biology GTAs described by Hammrich (1996), but the function of grading as providing effective feedback to learners is not identified as such.

DISCUSSION AND CONCLUSION

The workshop differs in several important aspects from others described in the literature. As previously noted, it finds a middle ground between generic and discipline-specific content. As well, its modular structure, which can be scheduled in various ways, is well matched to a clientele whose participation is voluntary and additional to their other responsibilities. More importantly, however, this format facilitates the evolution of the workshop in response to changing demands and greatly simplifies the task of preparing new TTFs as facilitators. As TTFs leave the project, typically after two years, their particular modules become available, and so their successors need take ownership only of these modules, not of the entire workshop. With the lapse of time, of course, all modules do acquire new owners, ensuring a reworking of the entire workshop.

But the most significant aspect of the workshop is that it was designed and is therefore owned by the TTFs themselves. Their prior exposure, in the Teaching and Learning in Higher Education course, to the language and principles of educational theory enables them to integrate their experience as GTAs in their respective disciplines into a common framework. Consequently, their original decisions about format and content led to the creation of a workshop uniquely designed to address the needs of their peers. Their continuing involvement ensures that it remains fresh, current, and relevant to the changing needs of GTAs in the Faculty of Science.

Almost as important, the workshop is facilitated by the TTFs. In addition to reinforcing their sense of ownership and providing resources to the Tomlinson Project that are unavailable in other ways, this function is a particular example of so-called peer-to-peer teaching, which typically gives rise to significant advantages for both instructors and participants. Another example of peer-to-peer teaching is described by Hiiemae et al. (1991), where the outstanding, experienced GTAs employed as teaching fellows are "able to share their experiences in a ... manner that, in all likelihood, could not be achieved by senior faculty" (p. 130); in the smaller-scale situation described by McComas and Cox-Petersen (1999), graduate students in science education act as instructional mentors to the GTAs, often in discipline-specific teams. Other examples have experienced GTAs acting as one-on-one mentors to newcomers (Boyle & Boice, 1998) or as volunteer GTA "consultants" working with other GTAs either individually or in groups (Marincovich & Gordon, 1991). Equally telling are the advantages of a co-facilitation model for the preparation of GTAs in engineering (Hollar et al., 2000), which is similar in many respects to the present model in that "the co-facilitation model shifts some of the burden of training the facilitators to the facilitators themselves" (p. 180).

Even from the beginning, however, the design of the workshop and its implementation were regarded only as a starting point. Eventually, it was hoped that the workshop would evolve — with more resources provided by the faculty or the university, with the active participation and support of the TA union and the science departments, and with additional components to address specific TA responsibilities, such as laboratory work in the different disciplines. Some progress has indeed been made in some of these directions: the university is beginning to implement a campus-wide program for GTAs, using the existing workshop as a reference and the existing TTFs as resource persons, and preparation for teaching was one element of recent negotiations for a new TA contract.

Evidence of the success of the workshop and, by extension, its conception, implementation, and continuing evolution takes several forms, bearing, respectively, on the participants, the university, and the TTFs themselves. Most direct are the results of the participants' post-workshop evaluations, designed by the workshop coordinator, which have from the beginning been consistently high for all aspects of the workshop (ranging between 4 and 5 on a Likert scale of 1

to 5). However, plans to revisit these evaluations after the lapse of time, perhaps along the lines described by Jones (1993), have yet to be implemented.

In institutional terms, the workshop has been adopted by a second faculty in its university of origin and by at least one other (Canadian) research-intensive university, evidence that its reputation has begun to reach beyond its roots. The benefits to the TTFs themselves will be described at length in an account of their experiences that they are currently preparing for publication; these benefits will certainly include not only a sense of having "made a difference" in their home institution but also an appreciation of their personal development as teachers (Marincovich & Gordon, 1991). Indeed, several of the TTFs who have now graduated are deploying their experience in their positions as university faculty.

REFERENCES

Austin, A. E., & Wulff, D. H. (2004). *The challenge to prepare the next generation of faculty*. San Francisco: Jossey-Bass.

Biggs, J. B. (1996). Enhancing teaching through constructive alignment. *Higher Education*, *32*, 347–364.

Boyle, P., & Boice, R. (1998). Systematic mentoring for new faculty teachers and graduate teaching assistants. *Innovative Higher Education, 22*(3), 157–179.

Entwistle, N. (2005, September). *Ways of thinking and ways of teaching across contrasting subject areas*. Paper presented at the conference on Improving Student Learning, London, UK. Retrieved September 22nd, 2009, from http://www.etl.tla.ed.ac.uk//publications.html

Golde, C. M., & Dore, T. M. (2001). *At cross purposes: What the experiences of doctoral students reveal about doctoral educatio*n. Philadelphia: The Pew Charitable Trusts.

Golde, C. M., & Dore, T. M. (2004). *The Survey of Doctoral Education and Career Preparation: The importance of disciplinary contexts*. San Francisco: Jossey-Bass.

Gonsalves, A., Harris, d., & McAlpine, L. (2009). The zones framework for both teaching and learning: Application to graduate student teaching assistants. *Journal of Further and Higher Education*, *33*(3), 205–218.

Hammrich, P. L. (1996). The impact of teaching assistants' conceptions on college science teaching. *The Journal of Graduate Teaching Assistant Development, 3*(3), 109–117.

Harris, d. (2004). The challenge to unlearn traditional language. In A. Saroyan & C. Amundsen (Eds.), *Rethinking teaching in higher education* (pp. 169–185). Sterling, VA: Stylus.

Hiiemae, K., Lambert, L., & Hayes, D. (1991). How to establish and run a comprehensive teaching assistant training program. In J. D. Nyquist, R. D. Abbott, D. H. Wulff, & J. Sprague (Eds.), *Preparing the professoriate of tomorrow to teach* (pp. 123–134). Dubuque, IA: Kendall/Hunt.

Hollar, K., Carlson, V., & Spencer, P. (2000). 1+1=3: Unanticipated benefits of a co-facilitation model for training teaching assistants. *Journal of Graduate Teaching Assistant Development, 7*(3), 173–181.

Jones, C. N. (1991). Campus-wide and departmental orientations. The best of both worlds? In J. D. Nyquist, R. D. Abbott, D. H. Wulff, & J. Sprague (Eds.), *Preparing the professoriate of tomorrow to teach* (pp. 135–141). Dubuque, IA: Kendall/Hunt.

Jones, J. L. (1993). TA training: From the TA's point of view. *Innovative Higher Education*, *18*(2), 147–161.

Kolb, D. A. (1994). Learning styles and disciplinary differences [reprint]. In K. A. Feldman & M. B. Paulsen (Eds.), *Teaching and learning in the college classroom* (pp. 151-163). Needham Heights, MA: Simon and Schuster.

Lawrenz, F., Heller, P., Keith, R., & Heller, K. (1992). Training the teaching assistant. *Journal of College Science Teaching, 22*, 106–109.

Luft, J. A., Kurdziel, J. P., Roehrig, G. H., & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science laboratories at a doctoral/research university. *Journal of Research in Science Teaching, 41*(3), 211–233.

Luo, J., Grady, M., & Bellows, L. (2001). Instructional issues for teaching assistants. *Innovative Higher Education, 25*(3), 209–230.

Marincovich, M. (1996). Teaching teaching: The importance of courses on teaching in TA training programs. In M. Marincovich, J. Prostko, & F. Stout (Eds.), *The professional development of graduate teaching assistants* (pp. 145–162). Boston: Anker.

Marincovich, M., & Gordon, H. (1991). A program of peer consultation: The consultants' experience. In J. D. Nyquist, R. D. Abbott, D. H. Wulff, & J. Sprague (Eds.), *Preparing the professoriate of tomorrow to teach* (pp. 175–183). Dubuque, IA: Kendall/Hunt.

McComas, W. F., & Cox-Petersen, A. M. (1999). Enhancing undergraduate instruction: The G-Step Approach. *Journal of College Science Teaching, 29(*2), 120–125.

McEwen, L. A., Harris, d., Schmid, R., Vogel, J., Western, T., & Harrison P. (2009). Evaluation of the Redesign of an Undergraduate Cell Biology Course. *CBE – Life Sciences Education, 8,* 72–78.

McKeachie, W. J., & Svinicki, M. (2006). *Teaching tips: Strategies, research, and theory for college and university teachers* (12th ed.). Boston: Houghton Mifflin.

Menges, R. J., & Rando, W. C. (1989). What are your assumptions? Improving instruction by examining theories. *College Teaching, 37*(2), 54–60.

Piccinin, S., Farquharson, A., & Mihu, E. (1993). Teaching assistants in Canadian universities: An unknown resource. *Canadian Journal of Higher Education, 23*(2), 104–117.

Preparing Future Faculty (PFF). (2009). Home page. Available at http://www.preparing-faculty.org/

Pruitt-Logan, A. S., Gaff, J. G., & Jentoft, J. E. (2002). *Preparing future faculty in the sciences and mathematics: A guide for change*. Washington, DC: Council of Graduate Schools and Association of American Colleges and Universities.

Roehrig, G., Luft, J., Kurdziel, J., & Turner, J. (2003). Graduate teaching assistants and inquiry-based instruction: Implications for graduate teaching assistant training. *Journal of Chemical Education, 80*(10), 1206–1210.

Ronkowski, S. A. (1996). The disciplinary/departmental context of TA training. In M. Marincovich, J. Prostko, & F. Stout (Eds.), *The professional development of graduate teaching assistants* (pp. 41–60). Boston: Anker.

Rushin, J. W., De Saix, J., Lumsden, A., Streubel, D. P., Summers, G., & Bernson, C. (1997). Graduate teaching assistant training. *The American Biology Teacher, 59*(2), 86–90.

Saroyan, A., & Amundsen, C. (1995). The systematic design and implementation of a training program for teaching assistants. *Canadian Journal of Higher Education, 25*(1), 1–18.

Saroyan, A., & Amundsen, C. (2004). *Rethinking teaching in higher education*. Sterling, VA: Stylus.

Schönwetter, D. J., Ellis, D., Taylor, L., & Koop, V. (2008). Title of Article??? *Journal of Graduate and Professional Student Development, 11*(1), 7–29.

Shannon, D. M., Twale, D. J., & Moore, M. S. (1998). TA teaching effectiveness: The impact of training and teaching experience. *Journal of Higher Education, 69*(4), 440–466.

Shulman, L. (1986). Those who understand: Knowledge in teaching. *Educational Researcher, 15*(2), 4–14.

Speer, N., Gutmann, T., & Murphy, T. (2005). Mathematics teaching assistant preparation and development. *College Teaching, 53*(2), 75–80.

Tanner, K., & Allen, D. (2006). Approaches to biology teaching and learning: On integrating pedagogical training into the graduate experiences of future science faculty. *CBE – Life Sciences Education, 5*, 1–6.

Tomlinson Project. (2009). Home page. Available at http://www.mcgill.ca/science/tpulse/

Travers, P. (1989). Better training for teaching assistants. *College Teaching, 37*, 147–149.

Wulff, D. H., Nyquist, J. D., & Abbott, R. D. (1991). Developing a TA program that reflects the culture of the institution: TA training at the University of Washington. In J. D. Nyquist, R. D. Abbott, D. H. Wulff, & J. Sprague (Eds.), *Preparing the professoriate of tomorrow to teach* (pp. 113–122). Dubuque, IA: Kendall/Hunt.

APPENDIX 1

Course Description and Learning Outcomes for the Teaching and Learning in Higher Education Course. This material was provided by Marcy Slapcoff and corresponds to the course as offered in 2007.

Course Description

This three-credit graduate course focuses on the design, development, delivery, and evaluation of a university or college level course. Students will learn about principles of course design, apply them to the development of a course, teach brief segments of this course, and receive feedback from the instructor and fellow students. By the end of this course, students will have a portfolio that includes a course plan, course outline, course description, learning outcomes, and descriptions of instructional and assessment strategies.

Course Learning Outcomes

At the end of the course, you should be able to:

1. Apply design principles to the design of a specific course
   a. Develop a course systematically based on design principles.
   b. Demonstrate the use of concept mapping for selecting and depicting content.
   c. Articulate clear and appropriate learning outcomes.
   d. Assess the strengths and weaknesses of various teaching strategies in relation to your specified learning outcomes.
   e. Assess the strengths and weaknesses of various evaluation methods in relation to your specified learning outcomes.
   f. Develop a complete course plan and course outline.

2. Engage in reflective teaching
   a. Demonstrate skill and self-confidence in making presentations and leading discussions.
   b. Demonstrate skill and self-confidence in making instructional decisions.
   c. Incorporate principles from the assigned readings in the design of a course.
   d. Evaluate teaching and incorporate feedback in subsequent teaching.

APPENDIX 2

NEEDS ASSESSMENT SURVEY

The survey was distributed to professors and, in a slightly modified form, to GTAs during the early stages of planning for the workshop. The information compiled from the survey was anonymous and was used as one of several guides for the structure and objectives of the project. Respondents were asked to provide answers that corresponded to what they would find "the most useful" in a TA development program. They were also asked to identify their departmental affiliation.

1. In what way(s) have you worked with TAs? (you may submit more than one response)
   a) Professor
   b) Laboratory Manager/Coordinator
   c) Other (please give details)

2. How many years (in total) have you been involved in working with TAs?
   a) 1
   b) 2–4
   c) 5–10
   d) >11

3. Have the TAs in your courses ever received any teaching preparation for their positions?
   a) Yes
   b) No
   c) I don't know

4. If you answered Yes to question 3, how many hours of teaching preparation have your TAs received?
   a) < 2 hours
   b) 2–5 hours
   c) 5–10 hours
   d) 10–20 hours
   e) > 20 hours

5. In your opinion, have TAs in McGill's Faculty of Science received adequate formalized preparation for teaching? Please explain.

6. Are you interested in seeing TAs in the Faculty of Science have access to teaching development programs?
   a) Yes
   b) No

If you answered No to question 6, do not continue with the rest of the survey.

Items 7 to 13 should be answered according to the four responses given below.

A	B	C	D
I don't understand the topic	Not useful	Might be useful	Very useful

How useful are the following topics to adequately prepare TAs for their teaching responsibilities?

7. Teaching strategies for small classes (including discussions, problem sets, and tutorials)

8. Teaching strategies for large classes

9. Teaching strategies for laboratory sessions

10. Methods of assessing student learning (including grading and feedback)

11. Addressing classroom diversity (with respect to learning styles, cultures, genders, disabilities, etc.)

12. Conflict management (cheating, sexual harassment, difficult student relationships, etc.)

13. Discipline-specific teaching strategies/concepts

14. Of the following topics, choose the *two* that you believe would be the most useful in preparing TAs for their position.
   a) Teaching strategies for classes (discussions/tutorials, etc.)
   b) Teaching strategies for laboratories
   c) Methods of assessing student learning (grading and feedback)
   d) Classroom diversity and conflict management
   e) Discipline-specific teaching strategies/concepts

15. How do you think the TA preparation activity should be structured? Choose your most preferred format from the list below.
    a) Short session(s) (< 3 hours)
    b) Intensive session(s) (day-long each)
    c) A one-term course
    d) A year-long course
    e) An intensive orientation session, plus a series of short sessions
    Other (please give details)

16. How many hours of formalized preparation do you think TAs need?
    a) < 5 hours
    b) 5–15 hours
    c) 15–25 hours
    d) > 25 hours

17. Should some manner of formal recognition be provided to TAs upon completion of the activity?
    a) Yes
    b) No

18. If you answered Yes to question 17, please indicate whether this recognition should be in the form of: (choose *up to* two answers)
    a) Course credits applied to the program of study
    b) An official certificate recognized outside the University
    c) An official notation on the student's transcript
    d) An informal written attestation
    e) Other (please give details)

19. When should this activity take place? You may choose *up to* two answers.
    a) At the beginning of the term
    b) In the middle of the term
    c) Regularly throughout the term
    d) At the end of the term
    e) Other (please give details)

20. Should TA participation in a teaching preparation activity be mandatory?
    a) Yes
    b) No
    c) Recommended

21. If the following services were also available, which of these would be most useful to TAs? Choose *up to* two answers.
    a) A website with information on teaching and learning in science
    b) A resource centre for teaching and learning in science
    c) A consultant who could observe the TA's teaching and offer advice
    d) An experienced TA or faculty member who would serve as a mentor
    e) Other (please give details)

APPENDIX 3

Details of the Workshop

Short descriptions of the modules, taken from the material distributed to participants, are as follows:

Linking Theory to Experience

This module begins with the participants reflecting upon their previous experiences to identify some general positive learning characteristics. The participants are then introduced to a traditional and a contemporary teaching philosophy so that, as prospective teachers, they may begin to reflect upon how to implement the positive learning characteristics they have identified.

Preparing to Teach

Whether you are a lab demonstrator, a tutorial leader, or a grader, organization is key. This module offers a framework that will allow you to organize your teaching material in a meaningful way, to formulate effective learning outcomes, and to select teaching strategies that are appropriate for promoting learning no matter what the classroom size.

Using Questions to Promote Learning

Questions are not only a tool for testing student knowledge but also can be used to promote thinking and learning. Similarly, when a student asks a question, an opportunity is presented to provide a moment of learning instead of just giving out an answer. Strategies and practice in both of these situations throughout the module empower the TA to promote learning in their classroom.

Grading and Feedback

This module explores the challenges inherent in maintaining consistency and efficiency in grading and offers suggestions on how to deal with these challenges. The role of feedback in promoting student learning is also investigated.

Supplementary materials are also provided to participants in the form of a printed "Graduate Teaching Survival Guide," based on various sources such as TA guides from other universities and McKeachie and Svinicki's *Teaching Tips* (2006). Topics covered include: Getting Started: The First Day of Class; The Teaching Assistant's Role and Responsibilities; Preparing and Delivering Presentations; Leading Class Discussions; and Using Questions to Promote Learning. Examples from science education are incorporated to provide pertinent advice for graduate students in a research-intensive university. The provision of this material is the responsibility of the coordinator, as is the organization of reunions for workshop participants, one month post-workshop.

CONTACT INFORMATION

Professor dik Harris
Physics Department
McGill University
Montreal, QC
H3A 2T8
dik.harris@mcgill.ca

dik Harris is a professor in the physics department and the ex-director of the Tomlinson University Science Teaching Project at McGill University. His research interests include the disciplinary context of teaching and learning and the role of metacognition in physics problem solving.

Laura April McEwen has a background in psychology and sociology and a master's degree in educational technology and has been working to improve the quality of teaching and learning in higher education for more than 10 years. Laura was the coordinator of the Tomlinson workshop program for three years prior to commencing her doctoral studies in assessment and evaluation at Queen's University in the fall of 2006. Concurrently, she holds the position of Assessment and Evaluation Consultant in the Office of Health Sciences Education at Queen's. Her responsibilities focus on improving the use of assessment to support student learning in both undergraduate and post-graduate medical education.

ACKNOWLEDGMENTS

The authors acknowledge the guidance and support of Lynn McAlpine in the initial stages of the design process and the willingness of Virleen Carlson to share information about the Cornell program throughout the development phase. Alenoush Saroyan read an early version of the manuscript and made invaluable suggestions.